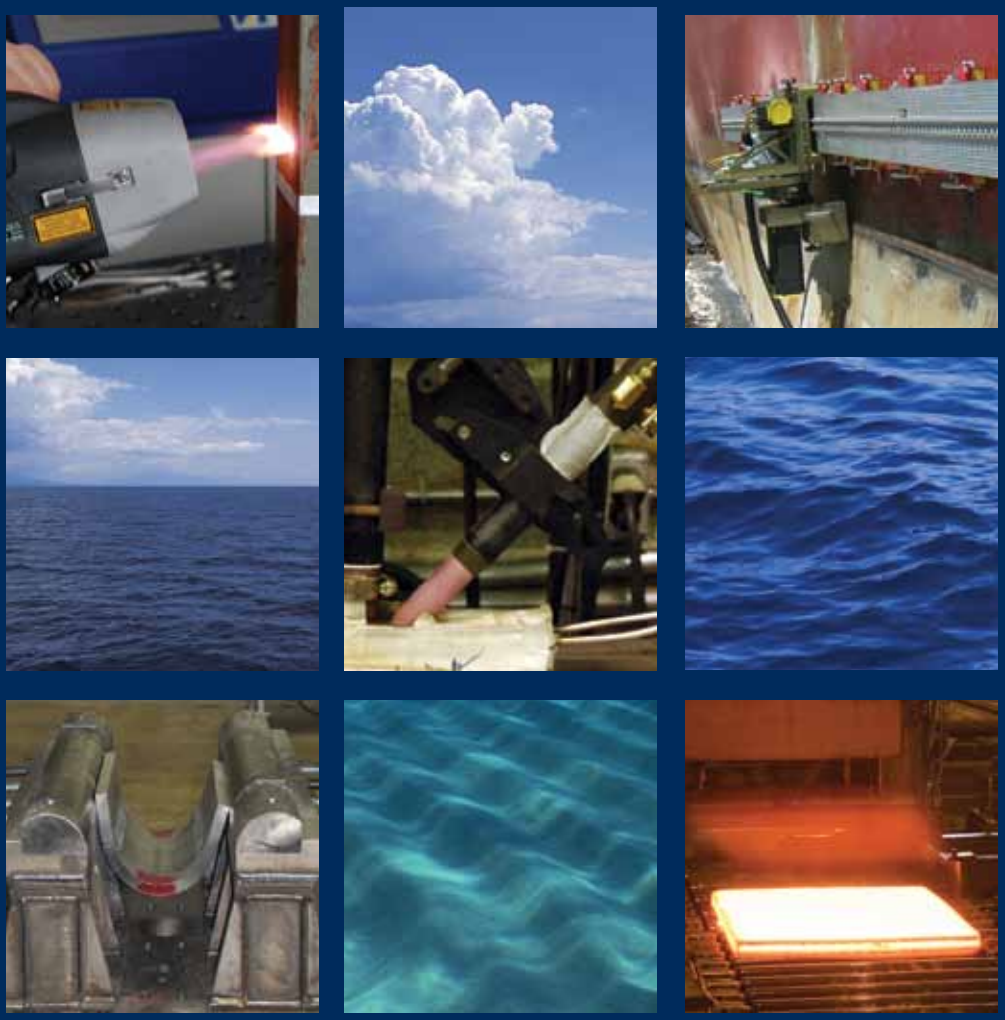
NMC Navy Metalworking Center

2009 Annual Report



Advanced Metalworking Solutions
For Naval Systems That Go In Harm's Way

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The Navy Metalworking Center (NMC) was established in 1988 as one of the Centers of Excellence of the Office of Naval Research's Manufacturing Technology (ManTech) program.

NMC is a national resource for the development and transition of advanced metalworking and manufacturing technologies, materials and related processes. NMC works in partnership with government, industry, weapon system prime contractors and Program Offices to develop and apply advanced metalworking and manufacturing technologies, materials and related processes. NMC drives new technologies from research and development to weapon systems application with two objectives:

- To implement new technologies that will improve weapon system performance
- To develop new production means for weapon system prime contractors and suppliers that lower the production cost of naval and other DoD weapon systems.

NMC has supported the U.S. Navy with affordable new metalworking technologies and capabilities that have responded to increasingly stringent requirements for greater agility, survivability and lethality.

NMC is operated by Concurrent Technologies Corporation, an independent, nonprofit organization located in Johnstown, Pennsylvania. For more information on NMC, visit www.nmc.ctc.com.

NMC Navy Metalworking Center

DIRECTORS' LETTERS

Reducing the acquisition cost of current and future platforms is a critical goal of the Navy, and the Navy Metalworking Center helps achieve this goal by developing, maturing, and transitioning advanced manufacturing technologies. For the past several years, NMC has supported the shipbuilding affordability goals of the Virginia Class Submarine, CVN 21, DDG 1000, and Littoral Combat Ship Programs.

The 2009 NMC Annual Report provides an excellent opportunity for you to read about NMC's recent technical achievements and implementation successes. Projects involving improved pipe preparation methods, HSLA-80 T-beams, and arc-cladding techniques are solving challenging technical issues while providing real cost reduction and cost avoidance.

This year, ManTech has broadened its affordability goal to include reducing the total ownership cost of the Virginia Class Submarine. NMC Program Officer Greg Woods, NMC Program Director Dan Winterscheidt, and NMC staff have been working with the Program Offices and shipyards to identify advanced manufacturing technologies that offer significant costs savings and return on the ManTech investment.

Together, Navy ManTech and NMC are making great progress in enhancing the affordability of Navy platforms. I am confident that NMC will continue to deliver technical excellence and to transition projects that improve critical Navy manufacturing processes.

Director, Manufacturing Technology Program
Office of Naval Research

While the Navy Metalworking Center provides tangible solutions to manufacturing issues, I frequently emphasize the importance of concentrating on less tangible, more fundamental principles in order to be successful. Those principles include focusing on client and stakeholder needs; retaining and recruiting the best talent; attaining true integrated project teamwork; and achieving real benefits through technology implementation. In theory, these principles may seem simplistic, even naïve. In practice, they are challenging to strive for and even more difficult to execute and master. I am pleased to report that by abiding by these principles, the NMC Program has been rewarded with a number of recent technical and transition successes.

Hybrid Laser-Arc Welded Sandwich Panels are being manufactured for DDG 1000 berms and personnel safety barriers, and the LASCOR project was the recipient of the 2008 Defense Manufacturing Technology Achievement Award. Weld seam facing tools are being used by Bath Iron Works for DDG 51 and DDG 1000 with additional functionality being developed for NGSB-GC to be used on amphibious ships and the Coast Guard's National Security Cutter. NGSB-NN has ordered 2,000 tons of HSLA-115 for CVN 78 construction that will begin in December. A web-based software system for the preparation and review of vendors' welding procedures is being used by NGSB-NN for CVN 78 and by GDEB for Virginia Class Submarines.

The underlying element in all of our technical achievements is the human element. People define our teams. It is the people from ManTech, the Program Offices, the shipyards, industry, and NMC who have consistently worked together to develop manufacturing technologies and demonstrated their ability to reduce the Navy's acquisition and total ownership costs.

Vince Lombardi was right when he said, "People who work together will win, whether it be against complex football defenses or problems of modern society." The Navy needs the best talent that the 21st century has to offer to solve Navy problems and successfully transition NMC project results. I look forward to building new relationships in the coming year and working together to implement advanced metalworking solutions for naval systems that go in harm's way.

Daniel L. Winterscheidt

Daniel L. Winterscheidt, Ph.D.
Program Director, Navy Metalworking Center

Littoral Combat Ship. Lockheed Martin photo

At his swearing-in ceremony as Secretary of the Navy in June 2009, the Honorable Ray Mabus recalled and upheld the conviction of the nation's first Secretary of the Navy, Benjamin Stoddert, who believed that a first-class Navy had to have first-class ships, built in first-class yards. It is toward this timeless goal that the Navy Metalworking Center (NMC) works with its partners in government, industry, and the shipbuilding community to implement innovative yet pragmatic solutions.

As an Office of Naval Research Manufacturing Technology (ManTech) Center of Excellence, NMC is currently focusing on four major platforms to achieve maximum benefit for the resources. This ManTech Affordability Investment Strategy is designed to reduce costs for DDG 1000, Littoral Combat Ship (LCS), CVN 21, and Virginia Class Submarine (VCS).

SHIPS

Manufacturing Improvements to Reduce Costs of DDG 1000 Construction

Prototype tools developed under an NMC project have been implemented at two shipyards building DDG 1000, the Navy's next-generation, multi-mission destroyer. The butt welding of exterior ship panels produces a weld protrusion that exceeds DDG 1000 fairness requirements. Currently, the shipyard removes approximately 23,000 feet of weld protrusions on each ship using a manual grinding process, which is labor intensive and slow. This increases shipbuilding costs, and the repetitive nature of hand grinding causes frequent injuries and costly medical expenses. The

Weld Seam Facing tools developed in this NMC project greatly reduce or eliminate the need for manual grinding. The automated tools remove the weld at a minimum rate of 20 feet per hour versus the current manual rate of three feet per hour. The savings for weld seam facing technology for butt welds on DDG 1000 is estimated at $750,000 per hull. Further, a modified version of the tool is being considered for weld joint back-gouging and welding, which will provide even greater savings. The Integrated Project Team (IPT) consists of Bath Iron Works (BIW), Northrop

Grumman Shipbuilding – Gulf Coast (NGSB-GC), General Dynamics Electric Boat (GDEB), Naval Surface Warfare Center-Carderock Division (NSWCCD), DDG 1000 Program Office (PMS 500), and PushCorp, Inc. NMC developed and validated the weld seam facing tool concept, the shipyards developed the tool requirements specification, and PushCorp, Inc., designed and manufactured the preproduction tools and is commercializing the product.

The American Bureau of Shipping (ABS), the technical authority for DDG 1000, has approved the use of an alternate method of manufacturing T-beams that was advanced through an NMC-led effort. T-beam stiffeners are used extensively for decks, bulkheads, shells and other structural ship applications. In an effort to reduce ship weight, T-beams are being manufactured from thinner, higher-strength materials. The tradeoff of that thinner material is significant distortion as the T-beams are fabricated. An NMC project has developed, qualified, and implemented a Hybrid Laser-Arc Welding (HLAW) process that shortens production rates and minimizes distortion in T-beams made of HSLA-80 steel. American Tank and Fabricating Company has purchased the necessary equipment and is under contract with Northrop Grumman Shipbuilding-Gulf Coast to provide hybrid laser arc-welded T-Beams for DDG 1000 construction. The system is expected to be qualified and operational before the end of 2009. Other potential platforms that could benefit include LCS, which uses a variety of thin section materials including ASTM A710, a material very similar to HSLA-80. Less distortion will reduce structural costs by $600,000 per ship. Higher weld speeds and reduced labor to set up the weld and straighten the beams after welding will lower fabrication costs 45 percent. Other project participants include PMS 500, Applied Thermal Sciences, Bath Iron Works, Northrop Grumman Shipbuilding – Newport News (NGSB-NN), NSWCCD, and the Naval Research Laboratory.

Automated weld seam facing on DDG 1000 ships will reduce costs $750,000 per hull due to decreased injury claims and direct labor. This tool is undergoing testing on DDG 51. Bath Iron Works photo

Automated weld seam facing on DDG 1000 ships will reduce costs $750,000 hull due to decreased injury claims and direct labor. This tool is undergoing testing on DDG 51. Bath Iron Works photo

The EX-100 pallet is used to package, handle, store and transport Long-Range Attack Projectile munitions and charges in the DDG 1000 Advanced Gun System (AGS). An NMC project has the potential to lower manufacturing costs of the AGS pallet system by 20 percent, or $5.5 million per hull, as well as reduce system weight, which will improve safety, handling, and survivability. To achieve these reductions, NMC is optimizing the manufacturing approaches developed during an earlier phase of this project, using friction stir welding (FSW) and advanced machining and casting techniques to produce a prototype

This prototype portable friction stir welding (FSW) machine is less expensive than traditional FSW systems because its functionality is limited to the specific needs of the shipyard. This machine is shown undergoing demonstration testing at the NMC facility in Johnstown, Pennsylvania. NMC photo

AGS pallet system that will be evaluated by BAE Systems, the project prime integrator. A Technical Data Package of proven manufacturing improvements and cost reductions will be delivered to BAE Systems and NAVSEA PEO IWS 3C for implementation into the Low-Rate Initial Production builds of the AGS pallet system early in 2011. Naval Surface Warfare Center Dahlgren Division and Port Hueneme Division are also providing technical contributions and oversight.

DDG 1000 hull treatment is the focus of a project that is expected to reduce costs by a total of $3.5 million per hull. NMC is evaluating various aspects of the hull treatment system, including alternative anti-corrosive paints and adhesives, efficient manufacturing methods of system components, removal of lead from the system, development of materials/processes to improve installation, and the identification and verification of a means to improve the system's durability. Costs will be reduced in procurement, installation, repair, and decommissioning of DDG 1000. The IPT also includes NSWCCD, the Navy Joining Center, NGSB-GC, and BIW.

The goal of a recently initiated NMC project for DDG 1000 is to drastically reduce the time necessary to join the deckhouse structure to the deck by allowing 6,200 feet of weld to be made in increments up to 20 feet rather than the 18 inches permitted by the current procedure. The current procedure was developed to prevent overheating of the adjacent non-metallic composite material. This project will develop welding and cutting processes to be used for welding the DDG 1000 deckhouse to the deck structure without exceeding the temperature limitations of the deckhouse composite. Work will include identifying and evaluating cooling mechanisms, if necessary. The reduction in joining time will decrease the labor associated with the task and result in better welds overall due to fewer starting and stopping transients. The results of this project will be implemented at NGSB-GC when the DDG 1000 deckhouse is attached to the deck in February 2010. PMS 500 and NSWCCD are also included in the project efforts.

LCS to Benefit from Manufacturing Solutions

In a project to benefit the Littoral Combat Ship (LCS) Program, NMC led an effort to design, build, and demonstrate a prototype low-cost, transportable friction stir welding (FSW) machine. FSW is a solid state joining technology that offers benefits over traditional welding for several materials. The low-cost FSW machine, which offers decreased distortion and improved joint properties, is less expensive than traditional FSW systems because its functionality is limited to the specific needs of the shipyard. The machine requires minimal site preparation, is sized for mobility among and within shipyards, and has simplified controls and operation that reduce the skill set and technical support required for the operator. In addition, by locating FSW operation at the construction yard, the aluminum panels that will be friction stir-welded are built to the size needed instead of being limited to what can be transported from a remote site. The prototype machine

will support construction of the next block of LCS in 2010. The dual-use machine design is available through NMC or Defense Technical Information Center for other programs or industries in need of flat, thin, stiffened aluminum panel production. This effort also includes the support of NSWCCD, ABS, Lockheed Martin Maritime Systems and Sensors (LM MS2), Marinette Marine Corporation (MMC), Advanced Joining Technologies, Friction Stir Link, and Nova Tech Engineering.

Manufacturing improvements will reduce construction costs for LCS waterjet inlet tunnel mid-section (shown) and entry edge. NMC photo

In July 2009, MMC initiated the procurement of a cast stem that was developed through another NMC project. The near-net-shape cast stem designed for the Lockheed Martin LCS provides for easy fit-up to ship structure, as well as improved accessibility for welding and inspection. The casting also greatly reduces both the costs and duration of shipyard construction and inspection. The lower installation costs is the result of the elimination of two complete installation processes and welding, inspection, and supervision costs. Other benefits include an improved design of the stem that allows easier connection with the hull plates and reduced production time for the bow. Construction of the bow section for LCS 3 is scheduled for completion by April 2010. The IPT included MMC, PMS 501, LM MS2, NSWCCD, Bollinger Shipyards, ABS, Gibbs & Cox, Newport News Industrial Products, and an independent casting consultant.

Casting is also one of the manufacturing improvements being considered in an NMC project involving LCS waterjet inlets, which have very particular geometry and smoothness requirements. Current shipbuilding practices available to LCS shipyards are not well suited to producing the intake details. In addition, the intakes are costly to produce in terms of labor and schedule. This project will provide development, testing, and evaluation of several promising design/technology concepts. The manufacturing solutions developed in this project will reduce both the production costs and shipyard duration for construction of the Lockheed Martin LCS. In particular, casting the tunnel entry edge is expected to save significant labor hours in fabrication and installation, improving the yard's ability to produce multiple ships in the fiscal year, as the current shipbuilding plan requires. Shipyard implementation is targeted for summer 2011; however, early insertion may be feasible. The IPT includes PMS 501, LM MS2, MMC, Bollinger Shipyards, ABS, and Gibbs & Cox.

Littoral Combat Ship. Lockheed Martin photo

CVN 78 and CVN 79 are the first two ships in the Navy's new Gerald R. Ford class of nuclear-powered aircraft carriers. This class offers many improvements over the previous Nimitz class of carriers, including the ability to handle more aircraft missions per day and reduced manning requirements, significantly reducing life-cycle costs.

CVN 78 is scheduled to enter service in 2015. NMC is contributing efforts to develop manufacturing methods that will optimize the carrier's performance and affordability.

CVN 78. U.S. Navy image

AIRCRAFT C

A high-strength low-alloy steel optimized through an NMC project will be used in the construction of CVN 78, significantly reducing topside weight, which will improve the center of gravity of the ship. ArcelorMittal photo

Varied Efforts to Improve Affordability Underway for CVN Program

The Future Aircraft Carriers Program Office (PMS 378) has approved for the construction of CVN 78 the use of a "high-strength, low-alloy" (HSLA) steel that was optimized through an NMC project. NMC worked to increase the performance and strength of HSLA-100 steel through heat treatment and processing to enable use of the new HSLA-115 (115 ksi yield strength) steel at reduced thickness, and thus, reduced weight, while meeting all performance requirements. Implementation of HSLA-115 on CVN 78 will result in 100-200 long tons of topside weight reduction per hull, which will help improve the ship's center of gravity. NGSB-NN procured the first order of HSLA-115 for CVN 78 in March 2009, and construction is scheduled to begin in December 2009. More than 2,000 tons of HSLA-115 will be ordered for CVN 78. Implementation of HSLA-115 was achieved ahead of schedule due to the combined efforts of the IPT, which includes PMS 378, NSWCCD, ONR, NMC, NJC, ArcelorMittal USA and DDL Omni. The team was instrumental in achieving project milestones

such as obtaining NAVSEA approval of the Material Selection Information (MSI) after extensive certification testing, first article testing, and vendor qualification; survivability testing for both plates and weldments; and NGSB-NN's weld cross qualification. In addition, NGSB-NN demonstrated acceptable forming and welded tie-down behavior with HSLA-115.

In another project aimed at the Navy's goal to reduce weight and lower the center of gravity for CVN 78, NMC has been leading an effort to advance LASer-welded corrugated-CORe (LASCOR) technology. LASCOR metallic sandwich panels are stiff, lightweight steel structures that offer the Navy corrosion resistance, reduced weight, and less distortion. LASCOR structures have been shown to typically reduce weight by 15 to 30 percent over conventionally fabricated structures for various applications. The project has optimized the LASCOR design for materials, manufacturability, joining, structural and protection performance, and cost, in order to support the transition of LASCOR to future Navy applications. The Future Aircraft Carriers Program Office (PMS 378), NSWCCD, NGSB-NN, Applied Thermal Sciences, and the Institute for Manufacturing and Sustainment Technologies partnered with NMC during this effort. Based on the work conducted in this project, a competitive solicitation initiated by General Dynamics Bath Iron Works (BIW) on the DDG 1000 Program resulted in a multi-million dollar contract to develop, test, and manufacture ship sets of Deck Edge Safety Berms and Personnel Safety Barrier Panels made from LASCOR. Delivery of the first two ship sets of Berm and PSB panels (DDG 1000 hulls 1001 and 1002) is currently scheduled for October 2011.

Implementation has begun on a project that will enable vendors to more successfully submit welding procedures that meet the Navy's requirements. The NMC project continued the development of a web-based software system that assists vendors in developing welding procedures that meet various Navy qualification and fabrication requirements. Specifically, the IPT extended the capabilities and cost savings associated with a prototype system developed and demonstrated under an ONR-sponsored Small Business Innovative Research (SBIR) project. Using the software tool, the rejection rate of vendors' first-time welding procedures is estimated to be reduced from above 90% to less than 20%. As a result, cost savings will be generated from reduced labor and production delays, increased competition among vendors, better vendor retention, and welding engineers' increased availability to focus on other process improvements. Estimated annual savings is approximately $2.58 million from vendor and shipyard labor savings alone if implemented at six major shipyards. The IPT included Weld QC, NGSB-NN, GDEB, PMS 378, and NSWCCD. Implementation began in August 2009 with a scaled set of NGSB-NN vendors for CVN 78. Subsequently, this implementation will be extended for use by other CVN 78 vendors. NGSB-NN is in the process of modifying licensing agreements with WeldQC to extend the use of this software tool to the NGSB-GC operations as well. Initial implementation began at GDEB in September 2009 for the VCS Program. The software system is also applicable to most non-nuclear-related welding on CVN 79, DDG 1000, LCS, Amphibious Transport Dock, and Auxiliary Dry Cargo Carrier.

NavWeld software is expected to reduce the rejection rate of vendors' submitted procedures from above 90% to less than 20%, along with the resulting additional costs. WeldQC, Inc., image

NMC is developing a prototype alternative brazing system to be used initially on CVN 78 and eventually on VCS and perhaps other platforms. For shipboard brazed pipe joints, NGSB-NN currently uses flame brazing, which is labor intensive because of the time required to achieve the melting temperature of the filler metal. In addition, the use of a manually manipulated torch occasionally causes damage to the surrounding area, further adding to shipbuilding costs. NGSB-NN has identified induction heating as an alternative method for brazing the majority of joints during shipboard installation of piping systems. Induction brazing takes advantage of induction heating's ability to deliver rapid, localized heat to the desired area. In addition, this process provides precise heat control for consistent heating and requires minimal training. However, current machines are too large to be operated within the confined space of the ship. The goal of this project is to develop a small, lightweight prototype induction heating system for brazing pipe joints shipboard, which will reduce the time required to braze each joint and the amount of rework and inadvertent hot-work damage from manual torch brazing. For CVN new construction, implementing this induction brazing

A laser ablation paint removal system will reduce labor costs and secondary waste compared to traditional paint removal methods. Adapt Laser Systems photo

technology will result in an estimated cost savings of $500K per hull. In addition, the proposed solution may benefit other platforms, including new VCS construction and CVN refueling and complex overhaul. The prototype will be implemented into the CVN construction process at NGSB-NN by 2011. PMS 378, PMS 450, NSWCCD, and NGSB-NN are also participating in this project..

NGSN-NN has implemented lessons learned from a project that identified optimal forming practices and maximum forming limits for nickel-based Alloy 625, which is difficult to form, particularly at room temperature. Thick-sectioned Alloy 625 plate was selected for the fabrication of several critical components on CVN 78. The objective of this project was to develop the required forming practices to enable the shipyard to achieve very large cold deformations in the fabrication of various components without impairing the mechanical/physical properties. A secondary objective was to document the corrosion performance of the weld interfaces between these components and the adjoining hull steel. Fabrication of these components was planned early in the production cycle for CVN 78; therefore, the forming practices resulting from this project were implemented in sufficient time to support the fabrication of these components. The project IPT, including PMS 378 and NGSB-NN, developed a test matrix where several forming variables were evaluated to characterize the forming parameters of this material. Forming tests were conducted on NMC's 850-ton forming press using tooling fabricated for this effort. The results of this project, specifically defined forming limits, welding preparation, drawing improvements, and preparation for blast and coat, have ensured the successful fabrication of these critical CVN 78 components. The benefits of the project include the prevention of construction schedule delays, the minimization of start-up problems that could arise due to the cold workability of this material, and the validation of corrosion performance of the components and weld interfaces in seawater to support a 50-year service life.

In a project expected to be incorporated into the CVN 68 class carrier maintenance procedures, NMC recently began evaluation of laser ablation technology as a cost-saving and environmentally safer alternative for removing paint. Removal of protective paints is required during in-service inspection, maintenance, and repair of Navy ships. Current paint removal methods are labor intensive and often generate significant amounts of secondary waste, such as used grit, sanding disks, and spent chemicals. Laser ablation technology has been demonstrated to be effective at removing paint without generating secondary waste; the removal of which adds tremendous cost as well as environmental impact. This project will evaluate the latest commercially available lasers to identify a laser ablation process with reduced overall cost and comparable ease of use and removal rate to existing methods. The results of this project are expected to be implemented at NGSB-NN and Norfolk Naval Shipyard in 2012. The IPT includes NGSB-NN and the Aircraft Carrier Maintenance Program (SEA 04XC).

AIRCRAFT

An NMC project is optimizing the laser peening process for potential use on Navy aircraft. Shown is the robotically controlled laser beam, which facilitates uniform peening of large and complex shaped components. Metal Improvement Company photo

While the majority of Navy Metalworking Center work focuses on the four ship platforms identified in its Affordability Investment Strategy, the Center has been called upon periodically to help address manufacturing needs of Navy aircraft.

Current projects are helping to optimize an innovative technology for use on two Navy air weapons systems and provide design analysis and expertise on another.

Evaluating Leading Edge and Practical Solutions

NMC is working with Metal Improvement Company, a division of Curtis-Wright Corporation, on a Naval Air Systems Command (NAVAIR)-sponsored project that is evaluating the potential benefits of laser peening to improve the strength and extend the life of critical highly stressed aircraft structural, turbine engine, and drive train components in the Navy inventory. Laser peening is similar in concept to shot peening, but it imparts higher compressive stresses much deeper into components with minimal surface plastic deformation. This project is developing and optimizing the laser peening process for specific Navy components through material evaluation, demonstration and validation tasks.

The Air Vehicle Systems Analysis (AVSA) project addressed design and maintenance enhancements for component, mission kit, and airframe service life of the MH-60R helicopter for the NAVAIR. NMC worked with North Island, Mayport, and Norfolk Naval Air Stations; Cherry Point In-Service Support Team; Lakehurst Naval Air Engineering Station; Lockheed Martin and Sikorsky Aircraft Corporation on this effort. NMC provided design, analysis, material expertise, logistical updates, and maintenance improvements for the aircraft's antenna gasket systems, the tail section stabilator bushings, Forward Looking Infrared/Hand-Control Unit, and airframe production drawings. The technology in this project resulted in reduced fleet support cost, improved maintenance, and higher mission availability for the war fighter.

MH-60R "Knighthawk" helicopter. U.S. Navy photo

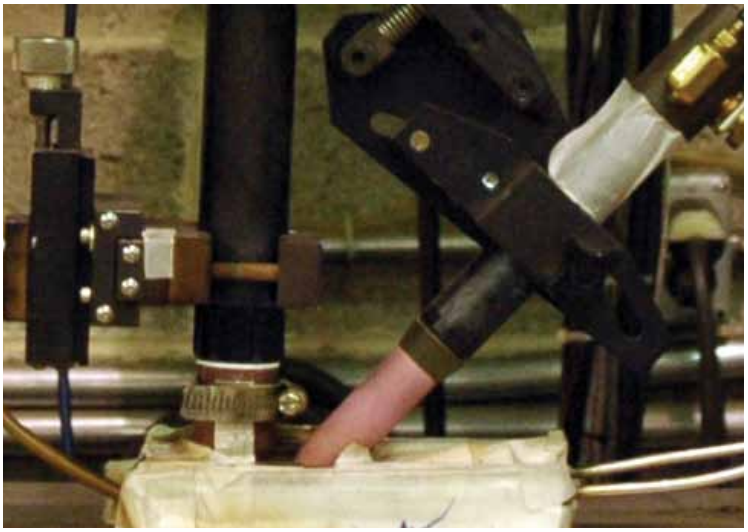
Virginia Class Submarine.
General Dynamics Electric Boat photo

The newest generation of attack submarines, Virginia Class Submarine (VCS), includes many manufacturing and technology advancements that will also reduce total ownership cost over the previous Seawolf class. Toward that end, this class of submarines is being built with a modular design so that new technologies can be integrated without extensive redesign. VCS will incorporate a process called Technology Insertion to implement advanced technologies as they become available. NMC is contributing to several projects that are optimizing manufacturing processes used on VCS.

SUBMARIN

Cost Savings Generated through Manufacturing Innovations

Based on the results of an NMC-led project, GDEB approved the purchase of a capital request to implement a modified hot wire gas tungsten arc cladding process that will reduce cycle time and allow for $1.2 million in savings over the remaining VCS Program. Currently, the shipyard uses hot wire gas tungsten arc welding (HW-GTAW) in VCS production. The cladding rate of nickel-based materials onto HY-80- and HY-100-grade components is restricted by heat input, dilution rate and interpass temperature limits. This project was developed to evaluate several arc cladding processes, down-select a candidate process and demonstrate the ability to qualify the cladding procedure based on NAVSEA Tech Pub 248 requirements. The developed procedure was based on the present HW-GTAW process with the addition of a supplemental cold wire feed into the arc pool. The resultant process increased the deposition rate from the present level of 7 pounds per hour to 12.8 pounds per hour, achieved appropriate final weld layer chemical composition due to reduced dilution, and met all test requirements defined in Tech Pub 248. In addition to GDEB and PMS 450, NSWCCD and the Institute for Manufacturing and Sustainment Technologies were involved in this project.



A modified arc cladding process will reduce cycle time and save $1.2 million for the VCS Program. Arc Applications photo

ES

GDEB and NGSB-NN are implementing recommendations from a project that is improving the producibility of VCS weapons cradles, which will reduce the cost of each submarine. Weapons cradles are used to secure weapons from the time they are loaded onto the ship until just prior to their launch. Because a large amount of welding is used to fabricate the long, thin assemblies, it is difficult to construct them and meet the precise dimensional tolerances. This project quickly found ways to improve the producibility of weapons cradles with specific attention on manufacturing processes. Welding was the primary process of concern, but the IPT also considered other manufacturing processes including heat treatment, machining, and improved fixturing. The necessary work instructions, design changes, and training or procedural changes have been developed for 10 of 15 recommendations. These recommendations are conservatively estimated to save $160,000 per ship set. GDEB and NGSB-NN will partially implement the 10 recommendations for the weapons cradles being built for SSN 780 and fully implement those recommendations on cradles for SSN 781 in the spring of 2010. The IPT included the shipyards as well as PMS 450 and the Naval Undersea Warfare Center Newport.

Production of VCS Pipe Systems Improved

GDEB is using several welding tools and simplified inspection methods that were developed in an NMC project for smaller diameter (< 3-inch diameter) pipe details in VCS. Current VCS requirements include off-hull new construction pipe welding methods that involved complex configurations for smaller diameter pipe for set-up, fit-up, fixturing, and pipe welding applications. This project reduced the manual pipe preparation and welding process labor by 20 percent, or 9,000 man-hours per hull, by developing prototype pipe fitting and fixturing tools–a modified Accu-fit pipe tool and a ball pivot welding tool.

Los Angeles Class Submarine. U.S. Navy photo

NMC also developed a mobile weld fixture to be utilized in the welding of pipe bosses that has the potential to reduce manual welding pass labor time by 50 percent. The results of this project could also be applied to CVN, DDG 1000, and commercial shipyard pipe shops. In addition to the shipyards and VCS Program Office, NSWCCD also contributed as an IPT technical member.

Seamless Alloy 625 elbows originally demonstrated on an NMC project for VCS have been procured by NGSB-NN for CVN 78. NMC and the IPT confirmed that a closed-die, cold forming technique can be economically and successfully applied to Alloy 625 large-bore elbows on VCS piping systems. The new forming process results in minimal thinning of the wall thickness in the heel of the elbow, thereby allowing the wall thickness in the starting pipe to be reduced, which in turn reduces the amount of raw material required. Raw material cost savings are based on the current market price, which range from $660K to $150K per VCS ship set. In addition to the implementation at NGSB-NN for CVN 78, the project will position the forming vendor to compete in the next VCS multi-hull procurement by GDEB, starting with SSN 792. The new manufacturing process is applicable to new construction, overhaul, and repair and can be further extended to Alloy 625 piping systems on all Navy platforms. PMS 450, Nuflo, Inc., GDEB, and NGSB-NN were involved in this effort.

Implementing 15-5PH forgings for critical components of Navy submarines will improve mechanical properties, reduce material costs and eliminate periodic replacement of components.
Corry Forging Company photo

Manufacturing Investigations to Result in a More Cost-Effective VCS

NMC is leading a project investigating the substitution of a material used on the torpedo tube muzzle door operating linkage for the Los Angeles (SSN 688) and subsequent classes of Navy submarines. Several critical components are produced from K-Monel® (Ni-Cu-Al) forgings, which do not function as needed in a corrosive seawater environment and must be replaced after eight years of service. This project seeks to replace the K-Monel forgings with a modified 15-5PH steel, which provides improved mechanical properties and corrosion resistance. Critical forging and heat treating parameters will be developed that will result in material properties tailored for this specific application. By eliminating the need to periodically replace these critical components in the in-service fleet, the Navy has estimated the cost savings to be approximately $9.4 million over the remaining life of these 70 hulls. In addition, a 60-70 percent material cost savings is projected in VCS construction. This effort includes contributions from PMS 450, PMS 392, Naval Undersea Warfare Center, NSWCCD, and GDEB.

The results of a project involving alternative application methods and materials for select damping systems are targeted for implementation on SSN 786, pending successful results. This NMC project seeks to reduce the cost of select damping systems by 20 percent. With several thousand square feet of damping tile installed on each VCS, the total cost savings are estimated to be up to $2.5 million per hull. The initial phase of this effort evaluated several candidate technologies and down-selected based on potential to meet cost-reduction goals and technical risk. Multiple pressure sensitive adhesives were selected for continued evaluation under Phase II of the project. The current phase of the project is investigating modifications to the pressure sensitive adhesives to overcome technical issues. The IPT addressing these challenges includes PMS 450, GDEB, NGSB-NN, and NSWCCD.

Given the projected increase in VCS production rates and the two-boats-per-year initiative, GDEB's Groton and Quonset Point shipyards needed to determine if their facilities had sufficient capacity to meet the increased demand. This NMC project developed discrete event simulation models of the machine shops at both shipyards. The analyses show that the shops will be able to meet this increased production schedule by modifying manning schedules and making additional capital investments. GDEB's cost benefit analyses show that there is a potential cost avoidance of approximately $340,000 per year, which may be associated with the establishment and ongoing use of the machine shop models at Groton and Quonset Point. GDEB plans to continually update the simulation models with current data and practices. Actual changes to be implemented at the machine shops are being finalized as the production planning, machine shop management, and modeling teams at GDEB continue to evaluate additional scenarios using the simulation models. GEDB, PMS 450, and Applied Research Laboratory at Penn State contributed to this project.

NMC is working with NGSB-NN and PMS 450 to identify and implement technical solutions to several casting problems being encountered at the NGSB-NN Foundry, including inclusions (i.e., foreign particles) and entrapped hydrogen. Using the information gathered during the initial stage of this project, test castings are being prepared to evaluate several process improvements identified in this project. The goal is to reduce casting costs and delivery time by improving the cleanliness of high-strength steel during melting and casting, thereby increasing casting quality, improving mechanical properties, and reducing rework. Annual savings are estimated at $700,000. Casting delivery time will also be improved by an estimated 55 days for large steel castings. The clean steel technologies developed under this project are currently being incorporated into NGSB-NN Foundry standard operating procedures for steel castings that are used on VCS and other marine structures. NSWCCD and GDEB are also involved in this project.

INDUSTRY RECOGNITION AND OUTREACH

Defense Manufacturing Technology Achievement Award

The Navy Metalworking Center and key partners received the 2008 Defense Manufacturing Technology Achievement Award, which was given by the Department of Defense Joint Defense Manufacturing Technology Panel (JDMTP) in December 2008.

The team was honored for developing the LASer-welded corrugated-CORe (LASCOR) metallic sandwich panel technology that is currently being implemented on the DDG 1000 class of guided-missile destroyer ships and is saving the Navy considerable acquisition cost. NMC had lead responsibilities for advancing LASCOR technology: specifically to establish a lightweight, stiff and modular steel structural system to reduce weight and improve performance. The project was recognized for optimizing the LASCOR design for materials, manufacturability, joining, structural and protection performance and cost, as well as successfully manufacturing large (78 x 240-inch) LASCOR panels of CRES 2003, a lean duplex stainless steel from Allegheny Ludlum. Testing has shown that these panels provide enhanced strength, protection and corrosion resistance.

Pictured, left to right: David Roberts, Bath Iron Works; Steve Webber, Applied Thermal Sciences; Greg Woods, Office of Naval Research and NMC Program Officer; Adele Ratcliff, DoD ManTech Program; Ed Sheehan, CTC; Kevin Stefanick, NMC/CTC

ShipTech 2009

NMC facilitates ShipTech, a conference that attracts hundreds of people from the domestic shipbuilding industry, its supplier base, U.S. Navy Program Offices, and U.S. Navy-sponsored research programs. ShipTech 2009's theme centered on improving shipbuilding affordability, which leads to the ultimate goal of helping the Navy carry out its many missions with a sufficient number of ships that employ superior technology. ShipTech is sponsored by the Office of Naval Research and the National Shipbuilding Research Program. ShipTech 2010 will be held at the Beau Rivage Resort in Biloxi, Mississippi, on March 10-11. For more information, go to www.nmc.ctc.com.

Rear Admiral Nevin P. Carr, Jr., Chief of Naval Research, talked with NMC staff at ShipTech 2009, about the Center's current efforts to improve shipbuilding affordability.

NMC Navy Metalworking Center

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